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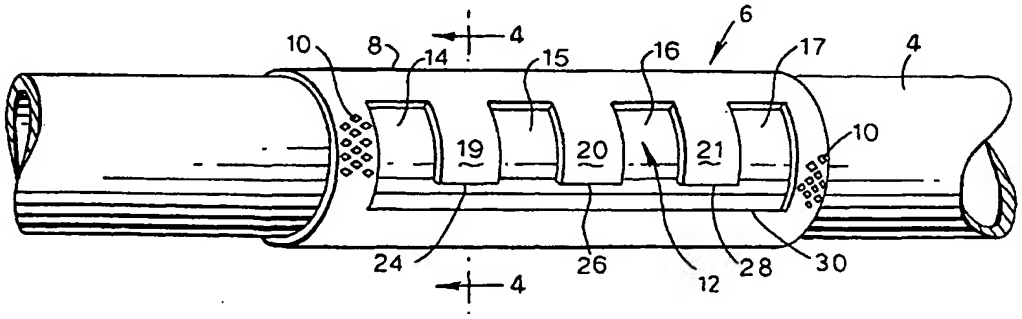
(54) Title: EXPANDABLE WELLBORE STABILISER



(57) Abstract: A stabiliser is disclosed for stabilising a radially expandable tubular element extending in a wellbore drilled into an earth formation. The stabiliser comprises a radially expandable tubular member selected from a section of the tubular element and a sleeve surrounding the tubular element, and at least one stabiliser arm connected to the tubular member, each arm being movable from a radially retracted position to a radially extended position by the action of a spring force. The stabiliser further comprises locking means arranged to lock each arm in the retracted position when the tubular element is in the unexpanded form and to unlock the arm upon radial expansion of the tubular member so as to allow the arm to move to the extended position thereof.

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EXPANDABLE WELLBORE STABILISER

The present invention relates to a stabiliser for stabilising a tubular element extending in a wellbore drilled into an earth formation. The tubular element is, for example, a casing, which is to be cemented in the wellbore. Generally it is desirable that the casing is positioned centrally in the wellbore before and during cementing in order to ensure that the annular cement layer between the casing and the wellbore wall provides sufficient isolation both in radial and longitudinal direction. In the specification hereinafter the terms "stabiliser" and "centraliser" are used, both referring to the same meaning.

Various types of centralisers have been applied to stabilise and centralise a tubular element, such as a casing, in a wellbore. One such centraliser is a bow centraliser, which is provided with spring-type arms extending against the wellbore wall. However, such known centralisers are less applicable for tubulars which are to be radially expanded in the wellbore.

It is therefore an object of the invention to provide an improved stabiliser, which adequately stabilises or centralises an expandable tubular element in a wellbore.

In accordance with the invention there is provided a stabiliser for a radially expandable tubular element extending in a wellbore drilled into an earth formation, the stabiliser comprising a radially expandable tubular member selected from a section of the tubular element and a sleeve surrounding the tubular element, and at least one stabiliser arm connected to the tubular member, each

arm being movable from a radially retracted position to a radially extended position by the action of a spring force, the stabiliser further comprising locking means arranged to lock the arm in the retracted position when the tubular element is in the unexpanded form and to unlock the arm upon radial expansion of the tubular member so as to allow the arm to move to the extended position thereof.

It is thereby achieved that, upon radial expansion of the tubular member in the wellbore, the tubular member stretches in circumferential direction so that the locking means becomes unlocked and each arm is moved by the spring force to its radially extended position. The arms thereby become biased against the wellbore wall and stabilise/centralise the tubular element in the wellbore.

Suitably each arm is integrally connected to the tubular member, and the spring force stems from elastic deformation of the arm relative to the member element when the arm is in its retracted position.

To enable easy installation of the tubular element in the wellbore, it is preferred that the arm, when in the retracted position thereof, extends in substantially circumferential direction of the tubular member.

Preferably the stabiliser comprises a plurality of said arms including at least two said arms located at substantially the same circumferential position and at selected mutual axial spacing.

To achieve adequate centralising of the tubular element in the wellbore, suitably the stabiliser comprises a plurality of said arms including at least three arms at selected mutual circumferential spacing.

The invention will be described hereinafter in more detail and by way of example with reference to the accompanying drawings in which:

Fig. 1 schematically is a perspective view of an expandable tubular element provided with an embodiment of a stabiliser according to the invention;

Fig. 2 schematically shows cross-section 2-2 of Fig. 1;

Fig. 3 schematically shows the tubular element of Fig. 1 after radial expansion thereof; and

Fig. 4 schematically shows view 4-4 of Fig. 3.

Referring to Figs. 1 and 2 there is shown a tubular element in the form of a casing 4, prior to radial expansion thereof, of a wellbore (not shown) formed in an earth formation. The casing 4 is provided with a stabiliser 6 for stabilising and/or centralising the casing 4 in the wellbore. The stabiliser 6 includes a radially expandable tubular member in the form of a sleeve 8 surrounding the casing 2. The sleeve 8 is provided with longitudinal slots 10 (only some of the slots are shown for ease of reference) which are overlapping in longitudinal direction so that only a low expansion force is required to radially expand the sleeve 8. Furthermore, the sleeve 8 is provided with three cut-out portions 12, 12', 12'' regularly spaced along the circumference of the sleeve 8, whereby in Fig. 1 only one cut-portion 12 is shown for ease of reference. The two other cut-out portions 12', 12'' are similar in shape and size to cut-out portion 12.

Cut-out portion 12 is formed of four rectangular cut-out sections 14, 15, 16, 17 which are interconnected by a longitudinal cut 18. The cut-out sections 14, 15, 16, 17 and longitudinal cut 18 define three rectangular arms 19,

20, 21 integrally connected to the remaining part of sleeve 8.

The longitudinal cut 18 extends inclined relative to the circumferential direction of the sleeve 8 thereby defining inclined circumferential end surfaces 24, 26, 28 of the respective arms 19, 20, 21 and complementary inclined circumferential end surface 30 of the remaining part of sleeve 8.

As shown in Fig. 2, the inclined end surfaces 24, 26, 28 of the arms 19, 20, 21 are locked behind the inclined end surface 30 of the remaining part of the sleeve 8, thereby retaining the arms 19, 20, 21 in a radially retracted position. Each arm 19, 20, 21 has been plastically deformed in a manner that the arm assumes a radially extended position (as shown in Fig. 3) when no longer radially retracted, and that the arm is subject to elastic deformation when radially retracted (as shown in Fig. 2).

Reference is further made to Figs. 3 and 4 showing the casing 4 and stabiliser 6 after radial expansion of the casing 4 and sleeve 8. The inclined end surfaces 24, 26, 28 of the arms 19, 20, 21 are no longer locked behind the inclined end surface 30 of the remaining part of the sleeve 8, and as a result the arms 19, 20, 21 extend in their respective radially extended positions.

During normal operation the casing 4 is provided with the stabiliser 4 whereby the sleeve 8 is arranged around the casing 4 and the arms 19, 20, 21 are in their retracted positions. Subsequently the casing is lowered into the wellbore and radially expanded by, for example, pulling or pushing an expander through the casing 4. Cement slurry is pumped into the annular space between

the wellbore wall and the casing 4 before or after expansion of the casing 4.

As the casing 4 radially expands, the sleeve 8 is also radially expanded. The slots 10 of the sleeve 8 thereby open up so that the force required to expand the sleeve is relatively low. The sleeve 8 stretches in circumferential direction as a result of its radial expansion, and thereby the inclined end surfaces 24, 26, 28 of the respective arms 19, 20, 21 become unlocked from the inclined end surface 30 of the remaining part of the casing 4. Each arm 19, 20, 21 springs radially outward against the wellbore wall upon unlocking of its inclined end surface 24, 26, 28 from end surface 30 due to release of the elastic deformation energy contained in the arm when the arm is radially restrained. The radial position of the arms 19, 20, 21 after unlocking is shown in Fig. 3.

The arms 19, 20, 21 are dimensioned such that the tips of the arms, after unlocking of the arms, become biased against the wellbore wall and thereby centralise and stabilise the casing 4 in the wellbore.

Instead of the sleeve being provided with longitudinal slots, the sleeve can be provided with a configuration of holes.

Furthermore, instead of cementing the casing in the wellbore, one or a number of alternative annular sealing means can be applied in the annular space between the casing and the wellbore wall.

C L A I M S

1. A stabiliser for a radially expandable tubular element extending in a wellbore drilled into an earth formation, the stabiliser comprising a radially expandable tubular member selected from a section of the tubular element and a sleeve surrounding the tubular element, and at least one stabiliser arm connected to the tubular member, each arm being movable from a radially retracted position to a radially extended position by the action of a spring force, the stabiliser further comprising locking means arranged to lock the arm in the retracted position when the tubular element is in the unexpanded form and to unlock the arm upon radial expansion of the tubular member so as to allow the arm to move to the extended position thereof.

2. The stabiliser of claim 1, wherein the arm is integrally connected to the tubular member and wherein the spring force stems from elastic deformation of the arm relative to the member element when the arm is in the retracted position thereof.

3. The stabiliser of claim 2, wherein the arm is defined by a cut-out portion of the tubular member.

4. The stabiliser of claim 3, wherein the arm, when in the retracted position thereof, extends in substantially circumferential direction of the tubular member.

5. The stabiliser of any one of claims 2-4, wherein the locking means includes a circumferential end surface of the arm, said end surface extending inclined relative to the circumferential direction of the tubular member.

6. The stabiliser of claim 5, wherein the locking means further includes a circumferential end surface of the tubular member, which end surface is inclined relative to the circumferential direction of the tubular member, the respective end surfaces of the arm and the tubular member having complementary inclinations.

7. The stabiliser of any one of claims 1-6, comprising a plurality of said arms including at least two said arms located at substantially the same circumferential position and at selected mutual axial spacing.

8. The stabiliser of any one of claims 1-7, comprising a plurality of said arms including at least three arms at selected mutual circumferential spacing.

9. The stabiliser of any one of claims 1-8, wherein the sleeve is an expandable slotted tubular member.

10. The stabiliser of any one of claims 1-9, wherein the tubular element is a casing extending into the wellbore.

11. The stabiliser substantially as described hereinbefore with reference to the drawings.

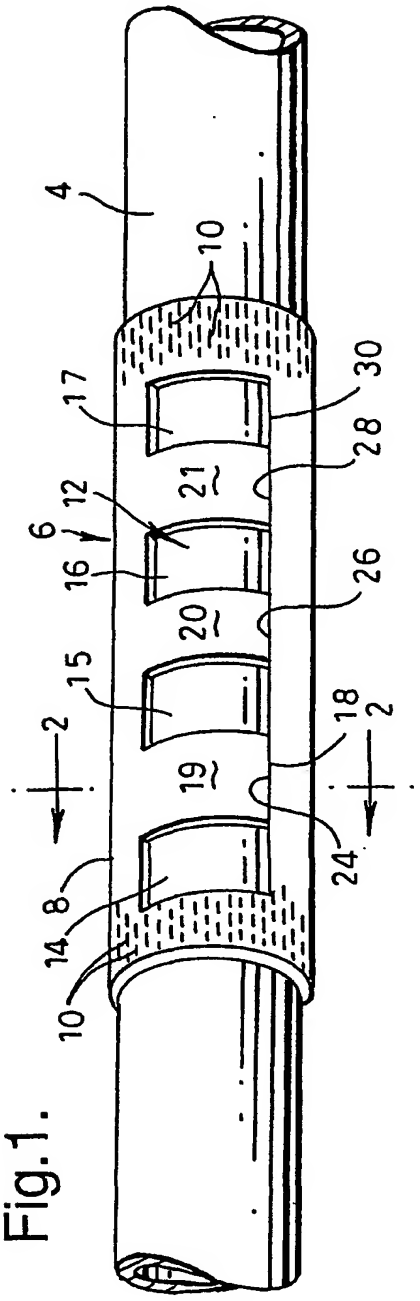
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Fig.1.

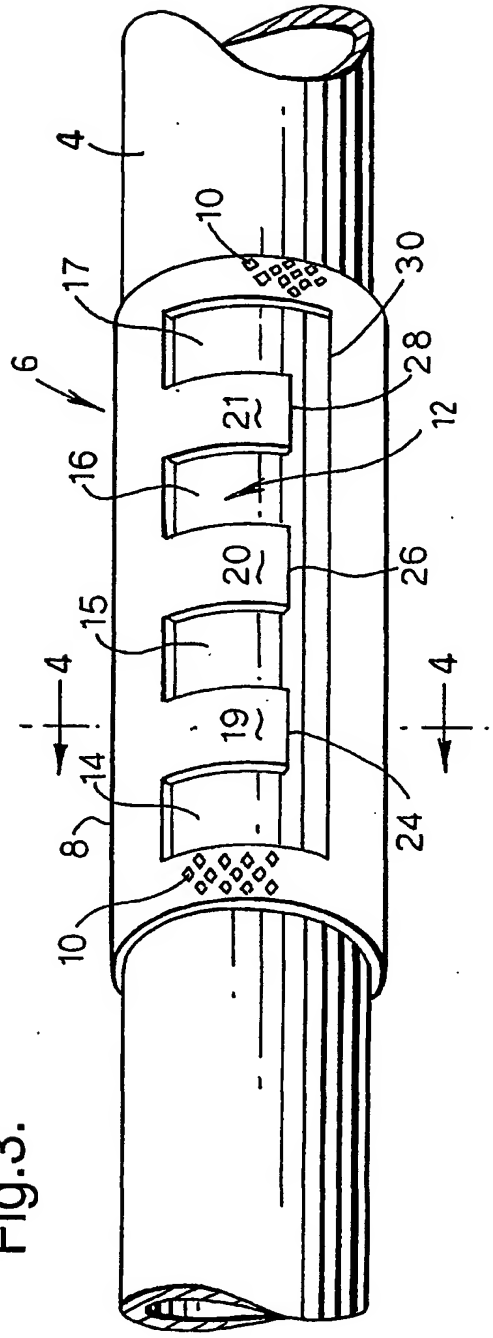
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Fig.3.

Fig.2.

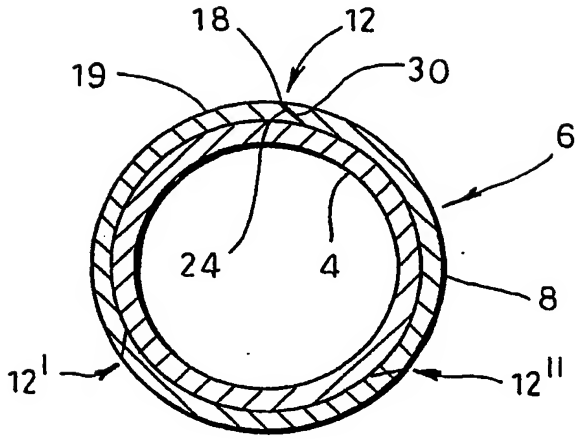
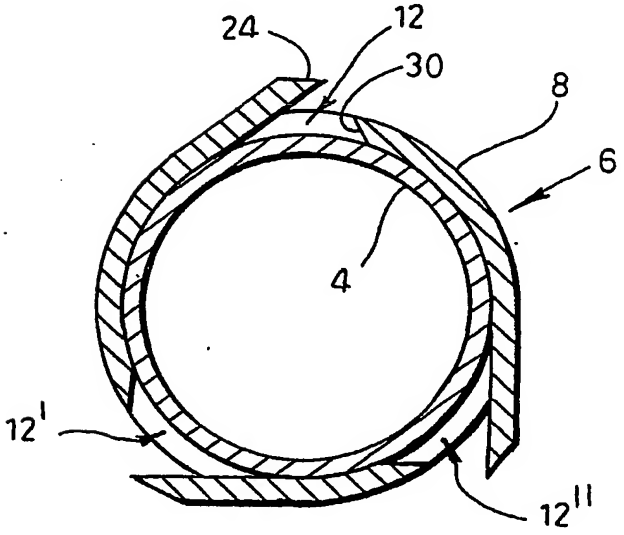


Fig.4.



INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
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According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 1 997 880 A (WATRY LOUIS T) 16 April 1935 (1935-04-16) figures 3,4	1
A	US 2 035 637 A (CRICKMER CHARLES S) 31 March 1936 (1936-03-31) figure 3	1
A	WO 99 18328 A (FORMLOCK INC) 15 April 1999 (1999-04-15) figures 1,2	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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